FACT SHEET
Bioremediation

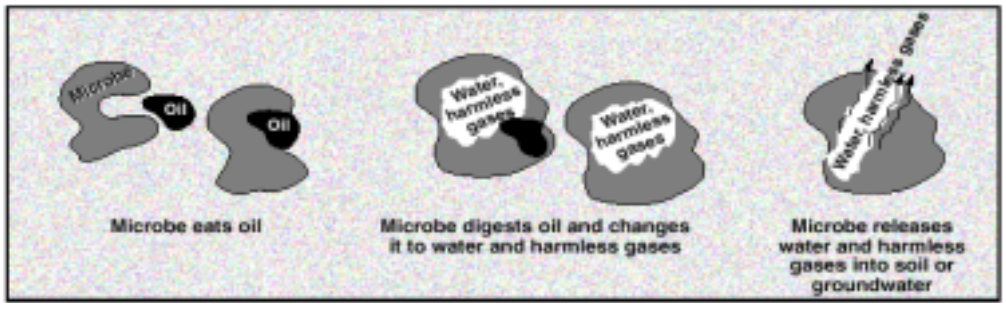
Department of the Navy RAB/TRC Training Workshop

What is Bioremediation?

Bioremediation is a general term used to describe the destruction of contaminants in soils and groundwater by biological mechanisms such as microorganisms (*or very tiny bugs, invisible to the naked*). In place, or *in situ,* bioremediation is a process in which indigenous or inoculated microorganisms (i.e. fungi, bacteria, and other microscopic bugs) degrade or metabolize organic contaminants found in soil and / or groundwater, converting them to harmless end products, all occurring in place.

How does Bioremediation work?

The microorganisms (*or microscopic bugs*) eat and digest organic substances for nutrients and energy. When the microorganisms completely digest chemicals, they change them into water and harmless gases, with an end product of clean soil, carbon dioxide, water, and cell material. In order for the microscopic bugs to clean up harmful chemicals, the right temperature, nutrients (fertilizers), and the right amount of oxygen must be present in the soil and groundwater. These conditions allow the microbes to grow and multiply—and eat more harmful chemicals. If the conditions are not right on site, they can be improved by pumping in air, adding nutrients, or other substances (like molasses) underground. Sometimes the microscopic bugs can even be added if there are not enough at the site.



Courtesy of EPA's "A Citizen's Guide to Bioremediation, April 2001 EPA 542-F-01-001

Ideal site conditions for bioremediation are not always available. When the weather at the site is too cold, or when the soil is too dense, the soil can then be dug up and cleaned above ground with the use of heaters and soil mixers to improve upon the site's conditions. After the soil is dug up nutrients are added and, for aerobic bioremediation, oxygen is introduced by stirring the soil or forcing air through it. However, some microorganisms work better without oxygen, and will eventually digest the contaminants to harmless gases. Mixing the soil can potentially lead to the evaporation of the harmful contaminants before the microscopic bugs can eat them.

To prevent these chemicals from polluting the air, the soil is mixed in a special tank or building where any chemical that evaporate can be collected and treated.

How long will Bioremediation take?

Remediation timeframes are gradual and depend upon several important factors. These factors vary from site to site. It can take anywhere from a few months to as long as several years for microscopic bugs to eat enough of the site's contaminants to clean the site.

Remediation Timeframe Factors
- Type and amount of contaminants present
- Size of the contaminated area
- Type of medium to be remediated (type of soil, or ground water)
- Digestion rates of the bugs.
- Climate

What are the advantages of using Bioremediation?

Bioremediation techniques have successfully been used to remediate soils, sludge, and ground water contaminated with petroleum hydrocarbons, solvents, pesticides, wood preservatives, and other organic chemicals. Bioremediation is often a preferable technology because it takes advantage of the natural processes. Polluted soil and groundwater can be cleaned at the site without having to move then somewhere else such as a landfill. If the ideal conditions exist or can be created underground, soil and groundwater can be cleaned without having to dig or pump it up at all. This allows cleanup workers to avoid contact with polluted soil and groundwater. It also prevents the release of harmful gases into the air, if applicable. However, there are many instances where bioremediation can be safely performed out in the open without fear of harmful gases. Because microscopic bugs changes the harmful chemicals into water and harmless gases, few, if any wastes are created. And often bioremediation does not require very much equipment or labor costs, and is therefore a cheaper alternative.

Where has the Navy implemented Bioremediation?

Bioremediation has been successfully implemented at the Naval Fuel Depot (NFD) Point Molate, a site contaminated with petroleum hydrocarbons was chosen as a demonstration pilot site for an enhance bioremediation process to clean up hydrocarbon contaminated soils. NFD Point Molate began operations in 1940, providing supply and support services such as fuel storage, handling and transfer to fleet and shore activities, and was closed under the Base Realignment and Closure act in 1995. The Naval Facilities Engineering (NFESC) is also hosting a project in which Equilon Westhollow Technology Center is teaming with Arizona State University to evaluate an aerobic *in situ* process for bioremediation of MTBE, the gasoline additive.

References

- Navy, 2000.*DON Environmental Restoration SMART Cleanup for Future Generations.*
- EPA, April 2001, *A Citizen's Guide to Bioremediation*, EPA 542-F-01-001

For further information visit:

http://www.epa.gov/superfund/sites
http://www.cluin.org
http://www.frtr.gov/matrix2/top_page.html
http://5yrplan.nfesc.navy.mil/